3. TECHNICAL DESCRIPTION OF THE QUAL2E IMPLEMENTATION IN WINDOWS

The QUAL2E Windows interface is designed to be as user-friendly as possible. The interface consists of 24 screens that cover all the data required by QUAL2E and QUAL2E-UNCAS. The first 20 screens represent the data for QUAL2E, and the last four screens are for QUAL2E-UNCAS. The screen input sequence for QUAL2E is given in Table 3.1. In general, the interface is divided into six data components: QUAL2E simulation control, a stream system, global variables, functional data, climatology data, and uncertainty analysis. The QUAL2E simulation control describes simulation control variables and number of reaches in the reach system. A complete stream system is described by the reach connection, element type, and a computational length. River reaches, which are aggregates of computational elements, are the basis of most data input. The global variables include number of constituents to be simulated, geographical and climatological information, option for plotting DO/BOD, and kinetics and temperature correction factors. The functional data provide flow data, reaction coefficients, and forcing functions. Initial conditions, boundary conditions, and point source loads are input as forcing functions. The global climatology data are required only for diurnal DO simulations. The uncertainty analysis (optional) data consist of types of uncertainty analyses, input and output conditions, and input variables with perturbations.

Of 24 screens, the first 3 screens where a complete stream system is entered are most important because the majority of the data on the following screens are dependent upon the information given by Screens 1-3. The stream system can be described by reach name, beginning and ending reach in terms of river miles or kilometers, and an indication of the headwater. The sequence of the reaches given on Screen 2 is used by the interface to display the reach connections. Each reach is then subdivided into computational elements of equal length, which are also displayed on the reach graphics screen. Once this information has been provided, the interface will automatically link all reaches to a stream system and assign the element types as headwaters, junctions, standards, or a downstream boundary on Screen 3.

There are seven different types of computational elements: headwater element, standard element, upstream element from a junction, junction element, downstream element, point source, and withdrawal element. A headwater element begins every tributary as well as the main river system, and therefore must always be the first element in a headwater reach. A standard element is one that does not qualify as one of the remaining six element types. An upstream element from a junction is used to designate an element on the mainstream that is just upstream of a junction. A junction element has a simulated tributary entering it. A downstream element is defined as the last element in a stream system. Point sources and withdrawals represent elements that have inputs (waste loads and unsimulated tributaries) and water withdrawals, respectively. Table 3.2 lists seven element types allowed in the QUAL2E input (represented below as numbers) and eight in the QUAL2E interface (indicated by capital letters).

Certain element types on Screen 3 are grayed out, such as headwater elements and junction elements. This means those types or fields cannot be changed. The only element types or fields that can be changed are the standard elements where the **S**s are located. The standard elements could be further defined as point sources, withdrawals, or dams. The user should indicate the locations of point sources, withdrawals, or dams if they are applied. River reaches and computational elements are the basis of most data input. Screen 4 is used to identify water quality parameters to be simulated. As mentioned previously, QUAL2E can simulate up to 15 water quality constituents in any combination desired by the user. Constituents that can be modeled are:

- Dissolved oxygen (DO)
- Biochemical oxygen demand (BOD)

Table 3.1 Input Screen Sequence in QUAL2E Windows Interface

Data Component	Description of Input Data	Content		QUAL2E Data Type	Interface	
					Input File	Input Screen No.
1	QUAL2E Simulation control	Title, simulation type, unit, time-step		1	*.RUN	1
		Uncertainty analysis, flow augmentation, trapezoidal channels, no. of reaches				
2	Stream system	Reach ID and river miles/km, headwater, comp., length		2		2
		Element type for each reach		3		3
3	Global variables	Water quality (no. of constituents)		Title line		4
		Geographical & climatological data	Lat., long., dust., elev., evap.	1		5
		Plot DO/BOD	List reach numbers to be plotted			6
		Observed DO file		*.DO		7
		Global kinetics, temp. correct. factor		1A, 1B	*.RUN	8,9
4	Functional data	Flow	Flow augmentation	3		10
			Hydraulic data/local climatology	5, 5A		11
		BOD/DO, algae, N, P, reaction coefficient		6, 6A, 6B		12, 13
		Forcing function	Initial conditions	7, 7A		14
			Incremental inflow	8, 8A		15
			Headwater	10, 10A		16
			Point loads/withdrawals	11, 11A		17
			Dams	12		18
			Downstream boundary	13, 13A		19
5	Climatolog-ical data	Global climatological data file		*.CLI		20
6	Uncertainty Analysis	Sensitivity analysis, first order error analysis, Monte Carlo simulation		1-6, 9	*.UNS	21
		Input conditions, output				
		Input variables for sensitivity analysis		8		22
		Input variables for first order and Monte Carlo analyses		*.VAR		23
		Reach (element) numbers to be printed		7	*.UNS	24

Table 3.2 Element Types Used in QUAL2E

ELEMENT TYPE	QUAL2E INTERFACE	QUAL2E MODEL
Headwater	H	1
Standard	S	2
Upstream of a junction	U	3
Junction	J	4
Most downstream	E	5
Point source	P	6
Withdrawal	W	7
Dam	D	

- Temperature
- Algae as chlorophyll *a*
- Phosphorus cycle (organic and dissolved)
- Nitrogen cycle (organic, ammonia (NH_3), nitrite (NO_3), nitrite (NO_2))
- Coliforms
- Arbitrary nonconservative constituent
- Three conservative constituents

Water quality constituents can be simulated under either steady-state or quasi-dynamic conditions. If either the phosphorus cycle or the nitrogen cycle is not being simulated, the model presumes they will not limit algal growth. Note that QUAL2E can simulate either ultimate BOD or 5-day BOD (BOD5).

The model simulates ultimate BOD in the general case. If the user wishes to use 5-day BOD for input and output, the program will internally make the conversion to ultimate BOD. On Screen 4, if only BOD is chosen, the ultimate BOD will be simulated; if both BOD and BOD5 are selected, the 5-day BOD input/output option is applied.

Geographical and climatological data are entered on Screen 5. Climatological data can be varied with reaches or constant throughout reaches depending on the simulation type. Temperature correction factors could be defaults by the model or user-specified. Also, if the user has observed DO data that are stored in a .DO file, that could be specified under **Observed Dissolved Oxygen file** on Screen 5. The observed data are stored on Screen 7.

Functional data are input on Screens 10 through 19. Flow characteristics of the reach system can be described by dispersion coefficients, discharge coefficients or a geographical representation (i.e., trapezoidal channels), and Manning's n. Flow augmentation may be applied when the DO concentration drops below some required target level.